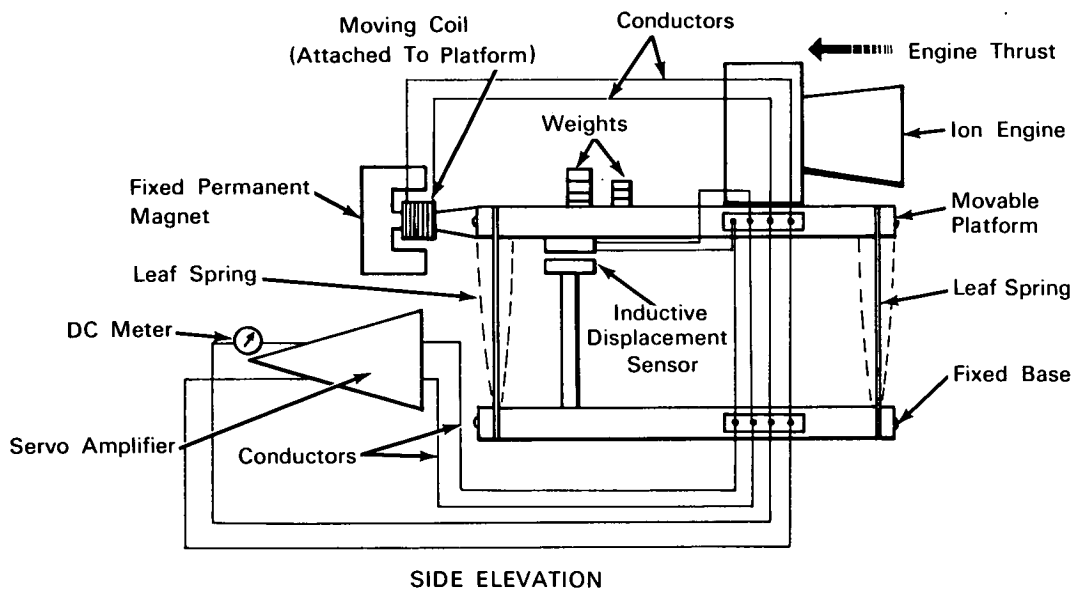


NASA TECH BRIEF



This NASA Tech Brief is issued by the Technology Utilization Division to acquaint industry with the technical content of an innovation derived from the space program.

Apparatus Measures Very Small Thrusts



The problem: Accurately measuring very small thrusts, 0.00001 to 0.001 lb, such as produced by ion propulsion engines.

The solution: Measurements are made by mounting the ion engine (or other low-thrust-producing device) on a horizontal platform supported on upright leaf springs that are loaded to have an essentially zero spring constant. An inductive displacement sensor and a counterthrust feedback system are included in the measuring apparatus.

How it's done: The ion engine is mounted on the horizontal platform which is supported by an upright leaf spring at each corner. The bottom ends of the springs are fastened to a fixed base which is parallel

to the platform. Initially, the rigidity of the leaf springs is more than adequate to support the platform and the ion engine. Before beginning a thrust measurement, the spring constant is made to approach zero (rigidity of the leaf springs reduced to almost zero) by placing a sufficient number of weights on the platform. When weight balance is achieved, a very small thrust produced by the engine will flex the springs, as indicated by the dashed lines, and displace the platform in a direction parallel to the base. Motion of the platform is detected by an inductive transducer, or sensor, which provides a signal through the servo amplifier to a magnet coil fixed to the end of the platform. The magnetic field produced by the current through the coil reacts against the field of the permanent magnet and produces the counterthrust to restore the

(continued overleaf)

platform to its initial position. This current also passes through the dc meter which is calibrated to indicate the thrust developed by the engine.

Notes:

1. An optical sensor could be used instead of an inductive sensor, which might be affected by the magnetic field associated with the ion discharge from the engine.
2. The magnet coil at the end of the platform can be interchanged with the permanent magnet attached to the fixed support without affecting the operation of the apparatus.

3. A related innovation is described in NASA Tech Brief B64-10224. Inquiries may also be directed to:
Technology Utilization Officer
Western Operations Office
150 Pico Boulevard
Santa Monica, California, 90406
Reference: B64-10284

Patent status: NASA encourages the immediate commercial use of this invention. It is owned by NASA and inquiries about obtaining royalty-free rights for its commercial use may be made to NASA Headquarters, Washington, D.C., 20546.

Source: Hughes Aircraft Company
under contract to Western Operations Office
(WOO-048)